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APPROACH AND LANDING TEST
NETWORK INTERFACE PROCESSOR
INTERFACE CONTROL DOCUMENT

APPROVED BY SISO

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DCN 1

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

1. SCOPE

1.1 General. This document establishes the design requirements for all external or interproject interfaces to the Network Interface Processor (NIP) located in Building 30 at the Lyndon B. Johnson Space Center (JSC), Houston, Texas. In addition to external interfaces, software/hardware and special interfaces are also described.

1.2 Interface Definition. Three classes of interfaces are described in this document as follows:

a. NIP External Interfaces. Any external hardware interface between the NIP and another system, subsystem, project, or facility. These interfaces are described in Section 3 of this document; refer to figure 1.

b. Software/Hardware Interfaces. Any interface used to transmit data to or from the Telemetry Preprocessing Computer (TPC). Descriptions of non-modified interfaces to standard computer peripherals are provided in the applicable referenced computer vendor documentation. These interfaces are described in section 4 of this document.

c. Special Interfaces. Unique, special purpose, modified, or unconventional interfaces used internal to the NIP that define hardware to software (interactive), software to software, or hardware to hardware interfaces will be described in Appendix A of this document as they are defined.

NOTE

Conventional component interfaces internal to the NIP, NCI or TPC are not defined in this specification. For the detailed description of these interfaces refer to the applicable hardware performance specifications.

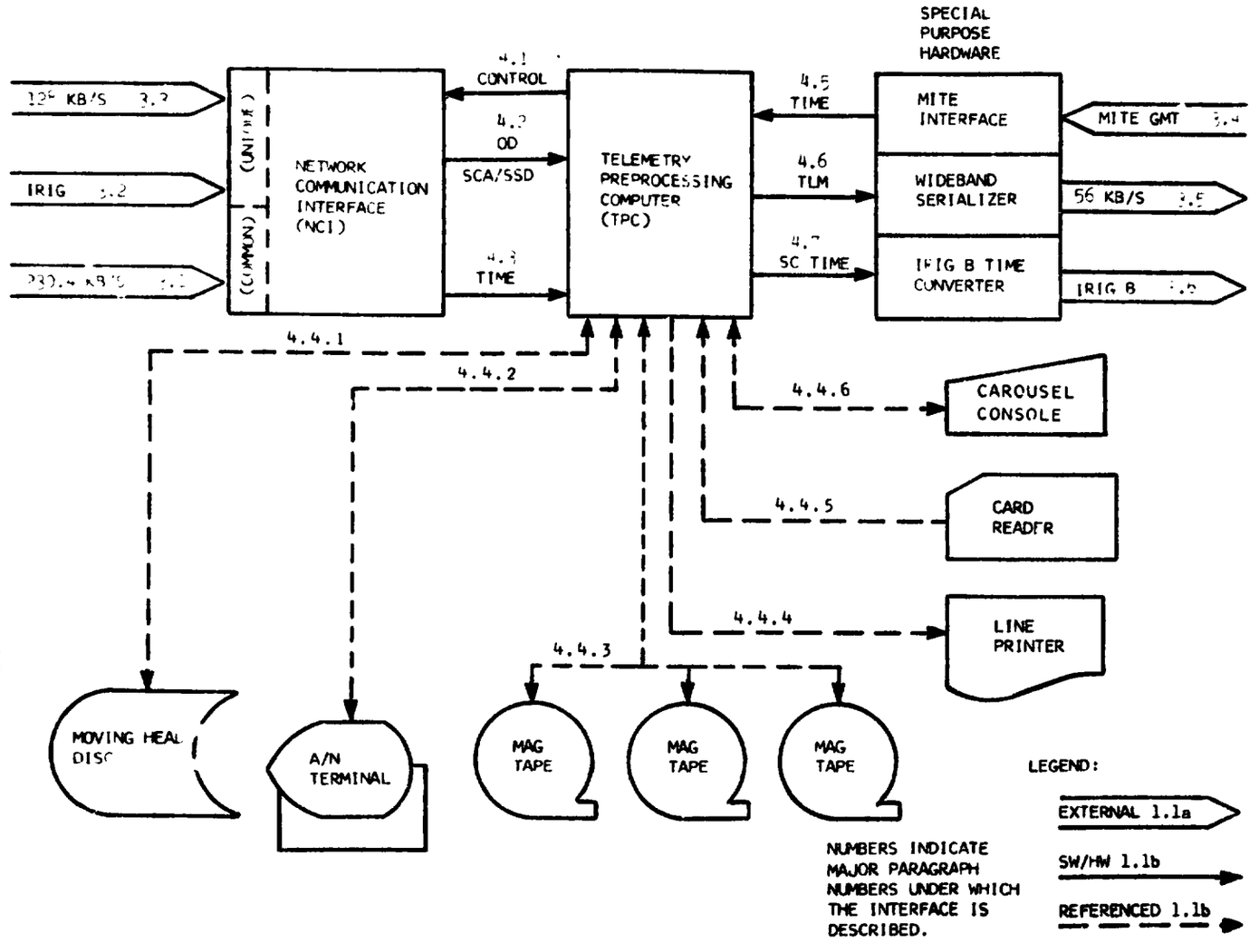


Figure 1. ALT/NIP Interfaces

2. APPLICABLE DOCUMENTS

2.1 General. The following documents, of the latest issue in effect, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Aeronutronic Ford Space Information Systems Operation (SISO)

SS-09600	Communication System Specification
SI-25820	Approach and Landing Test Data System Interface Control Document
JSC-10155 (SS-25839)	Approach and Landing Test Network Interface Processor System Specification
1S4000-00051	MCC Program General Requirements Specification
JSC-10022 (TN-615)	Network Interface Processor Requirements (Preliminary)
JSC-10017 (TN-817)	Approach and Landing Test/Network Interface Processor Requirements

Bell Telephone System

Unnumbered	Bell System Data Communications Technical Reference, Data Service Unit Interface Specification
Unnumbered	Bell System Interface Specification
Unnumbered	Bell System Data Communications Technical Reference, Data Set 203 Type Interface Specification

2.1 General. (continued)

Unnumbered	Bell System Data Communications Technical Reference, Data Set 303 Type Interface Specification
Unnumbered	Bell System Wideband Data Stations, Data Set 303 Type Interface Specification dated August 1966

PUBLICATIONS

National Aeronautics and Space Administration (NASA)

Unnumbered	Telemetry Data Format Control Book (TDFCB) for ALT

SISO

EX132	MCC In-Plant Cabling Standards

Electronic Industries Association (EIA)

RS-422	Electrical Characteristics of Balanced Digital Interface Circuits, dated April 1975
RS-232C	Interface Between Data Terminal Equipment and Data Communication Equipments Employing Serial Binary Data Exchange

Intermediate Range Instrumentation Group (IRIG)

IRIG 104-70	IRIG Standard Formats, dated August 1970

Interdata Inc.

29-422	MAM Instruction Manual
29-311	Universal Logic Interface Instruction Manual
29-387	40 Megabyte Disc Instruction Manual

2.1 General. (continued)

29-400	40 Megabyte Disc Drive Maintenance Manual
29-301	PASLA Instruction Manual
29-309	1600 CPI Magnetic Tape System Instruction Manual
29-309R05	1600 BPI Read-After-Write Magnetic Tape System Instruction Manual
29-313	New Series Line Printer Instruction Manual
29-316	Volume I, DPC 132 Manual
29-317	Volume II, DPC 132 Manual
29-302	NS Card Reader Interface Instruction Manual
29-305	M46-235 Card Reader Instruction Manual
29-383	Card Reader Hardware Hollerith to ASCII Code Converter Installation Manual
29-455	Carousel Terminal Reference Manual
29-456	Carousel Installation Reference Manual

3. NIP EXTERNAL INTERFACES

3.1 230.4 kb/s Wideband Input Interface. ALT telemetry data from Flight Research Center (FRC) shall be received by the GFE Interleaver via three 56 kb/s data circuits from the RCA Digital Satellite Network. The ALT telemetry data shall then be sent in block data format (BDF) to the NIP via a 230.4 kb/s line.

3.1.1 Interface Reference Documentation. The following reference documentation shall be used for the NIP input.

a. Signal Level Reference. Bell System Wideband Data Stations, Data Set 303 Type, dated August 1966.

b. Telemetry Data. For a detailed description of the FRC Telemetry Data refer to the Telemetry Data Format Control Book (TDFCB) for ALT.

3.1.2 Telemetry Interface - Electrical Characteristics. Logic levels and impedances shall be as specified in the Bell System Interface Specification. The following lines shall be utilized.

a. Serial Clock Receive (SCR)

b. Receive Data (RD)

3.1.3 Telemetry Interface - Physical Characteristics. The GFE Interleaver shall be located in Room 129, Building 30. The physical data interface shall be a connector mounted on the Interleaver and specified by the GFE Interleaver Specification. The Interleaver shall be connected to the wideband data (WBD) patch bay in Room 129 by NASA owned cables. Additional wideband input interfaces with identical electrical characteristics may be input to the WBD patch bay. Other sources currently identified for the ALT program are:

- Simulation data from JSC Building 5
- Wideband recorder outputs.

3.1.3 Telemetry Interface - Physical Characteristics. (continued)

Any one, but not more than one, source may be selected at the WBD patch bay and outputted to the Network Communications Interface Common (NCIC) rack located in Room 118, Building 30. Physical characteristics of this interface shall be as specified in SISO EX132.

3.2 Raw Operations Downlink IRIG Input Interface. Local time in IRIG A or IRIG B format shall be recorded on a separate track along with WBD described in Paragraph 3.3. At tape playback the IRIG signal, in modulated form, is input to a time code converter that contains the following options:

a. Days option (3 digits)

b. Milliseconds option (BCD format)

c. Computer Ready Option

d. 48 line parallel BCD output

e. IRIG A/IRIG B (switchable).

Output of the time code converter is supplied (parallel) to a SISO supplied IRIG serializer. The output of the IRIG serializer is then input to the NCIU. Both the time code converter and the IRIG serializer shall be located in Room 225, Building 30.

3.2.1 IRIG Serializer Output Electrical Characteristics.

a. Data Format. Days, hours, minutes, and seconds shall be in serial BCD, and milliseconds shall be in binary format as described in the ALT TDFCB BDF header time tag. See figure 2.

b. Data Rate. Nominal 1 Mhz.

c. Data and Control Lines. One serial data line, one clock line, and one gate control line.

WORD NO.	MSB 12									LSB 12	MSB 13					LSB 13
BIT NO.	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
BIT VALUE	200	100	80	40	20	10	8	4	2	1	20	10	8	4	2	1
UNIT CODE	JULIAN DAYS										HOURS					

WORD NO.	MSB 14							LSB 14	MSB 15							LSB 15
BIT NO.	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
BIT VALUE	40	20	10	8	4	2	1	40	20	10	8	4	2	1	-	-
UNIT CODE	MINUTES								SECONDS						SPARE	

WORD NO.	MSB 16							LSB 16	MSB 17							LSB 17
BIT NO.	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
BIT WT.	-	-	-	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0			
UNIT CODE	SPARE			0.125 MILLISECONDS = LSB												

Figure 2. IRIG Serializer Output Format

3.2.1 IRIG Serializer Output Electrical Characteristics. (continued)

d. Signal Levels. As described in Bell System Data Communications Technical Reference, Data Set 303 Type Interface Specification

e. Data Source. SISO supplied IRIG serializer located in Room 225 Building 30.

f. Data Destination. Network Communication Interface Unique (NCIU) rack located in Room 118, Building 30.

3.2.2 IRIG Serializer Output Physical Characteristics. Physical characteristics of this interface shall be three coaxial cables installed as described in SISO EX 132.

3.3 128 kb/s Wideband Air/Ground Input Interface. Raw orbiter output data recorded at FRC, or elsewhere, is the data source for this NCIU interface. This input data shall be used in conjunction with the Raw Operations Downlink (ROD) IRIG input described in Paragraph 3.2.

3.3.1 128 kb/s Wideband Air/Ground Input Electrical Characteristics.

a. Data Format. 128 kb/s A/G format; refer to the TDFCB for ALT.

b. Data Rate. 128 kb/s.

c. Data and Control Lines. One data line and one clock line.

d. Signal Levels. As described in Bell System Wideband Data Stations, Data Set 303 Type Interface Specification, dated August 1966.

e. Data Source. Wideband recorder playback from FACS.

f. Data Destination. NCIU 128 kb/s input ports located in room 118, Building 30.

3.3.2 128 kb/s Wideband Air/Ground Input Physical Characteristics. Physical characteristics of this interface shall be two coaxial cables installed as described in SISO EX132.

3.4 Master Instrumentation and Timing Equipment Input Interface. Greenwich Mean Time in the IRIG B format shall be supplied by the Master Instrumentation and Timing Equipment (MITE), along with MITE supplied pulse rates of 1MHz, 1kHz and 100p/s, to a SISO supplied MITE interface unit. The MITE interface unit shall be part of the NIP NCI special purpose hardware.

3.4.1 MITE Interface Electrical Characteristics.

a. Data Format. As described in IRIG Standard Formats, 104-70.

b. Data Rates. 1kHz modulated B format, 1MHz clock, 1kHz clock and 100 pulses per second clock.

c. Signal Levels. As described in IRIG Standard Formats, 104-70.

d. Data Source. MITE located in Room 319, Building 30.

e. Data Destination. Input to MITE interface unit special purpose hardware located in Room 118, Building 30.

3.4.2 MITE Interface Physical Characteristics. Physical characteristics of this interface shall be four twisted pairs installed as described in SISO EX132.

3.5 56 kb/s Wideband Serializer Output Interface. A wideband serializer shall be supplied as part of the NIP NCI. This component shall provide capability to operate at frequencies up to 1 Mb/s. The frequency source for operation may be selected to be either internal (56 kb/s for ALT) or external clock.

3.5.1 56 kb/s Wideband Serializer Output Electrical Characteristics.

a. Data Format. Serial as described in the TDFCB for ALT and paragraph 4.6 of this document.

b. Data Rate. 56 kb/s for ALT or externally supplied clock up to 1Mb/s.

c. Data and Control Lines.

1. Serial Clock Transmit (SCT)

2. Send Data

d. Signal Levels. As specified in Bell System Wideband Data Stations, Data Set 303 Type Interface Specification, dated August 1966.

e. Data Source. Wideband serializer component of NIP NCI special purpose hardware located in Room 118, Building 30.

f. Data Destination. Through WBD patch bay in MCC FACS to ALTDS data transfer and test subsystem (DTTS) for redrive and transmit to MDD and MODES.

3.5.2 56 kb/s Wideband Serializer Output Physical Characteristics. Physical characteristics of this interface are coaxial cable data and clock lines installed as described in SISO EX132.

3.6 IRIG B Spacecraft Time Output Interface. Spacecraft (onboard) time shall be stripped from the incoming telemetry stream by the TPC. The spacecraft IRIG B time converter, of the NIP NCI special purpose hardware, then provides the spacecraft time in IRIG B format to the users.

3.6.1 IRIG B Spacecraft Time Output Electrical Characteristics.

a. Data Format. Modulated B Format as described in IRIG Standard Formats 104-70.

b. Data Rate. Serial, 1kHz

c. Data Lines. Twisted Pair

d. Signal Levels. As described in IRIG Standard Formats 104-70

e. Data Source. Spacecraft IRIG B time converter component of the NIP NCI special purpose hardware located in Room 118, Building 30.

f. Data Destination. Users as required.

3.6.2 IRIG B Spacecraft Time Output Physical Characteristics. Physical characteristic of this interface is single twisted pair installed as described in SISO EX132.

4. SOFTWARE/HARDWARE INTERFACES

4.. NCIU Control Interface Component. The NCIU Control Interface Component shall provide the capability for the TPC to transfer setup data words to the NCIU for initialization purposes.

4.1.1 NCIU Control Interface Component/TPC Interface. The NCIU Control Interface Component to TPC interface shall be via the TPC multiplexer bus. This interface shall provide for the following information transfers:

- Command words from the TPC to the component via programmed I/O.
- Setup data words for the A/G Frame Synchronizer.
- Status words from the component to the TPC.

4.1.1.1 Command Words. The TPC shall control the operation of the component by executing Output Command Instructions to device address X '05'. The command word format is shown in figure 3. A start Setup Command and a Stop Setup Command shall be required.

4.1.1.2 Start Setup Command. The Start Setup Command shall set the component to the Setup Mode. Bits 9, 10, and 12 shall be set in the Start Command Word; all other bits shall be reset.

4.1.1.3 Stop Setup Commands. The Stop Setup Command shall reset the component from the setup mode. Bits 8 and 10 shall be set in the Stop Setup Command; all other bits shall be reset.

4.1.2 Setup Data Word. Setup data words destined for the A/G Frame Synchronizer component shall be transferred on a programmed I/O basis. Format for the Setup Data Word is shown in figure 4.

BIT	8	9	10	11	12	13	14	15
COMMAND	DI	EI	H/W	N/U	Set-up	READ MODE	N/U	N/U

BIT 8 Disable Interrupt

BIT 9 Enable Interrupt

BIT 10 Halfword. This bit shall be set in all commands

BIT 11 Not Used

BIT 12 Setup. Initializes the component to receive A/G Setup Words

BIT 13 Read Mode. Initializes the component to transmit delta time and BDF status. Refer to Paragraph 4.3

BIT 14 Not Used

BIT 15 Not Used

Figure 3. NCIU Control Command Word Format

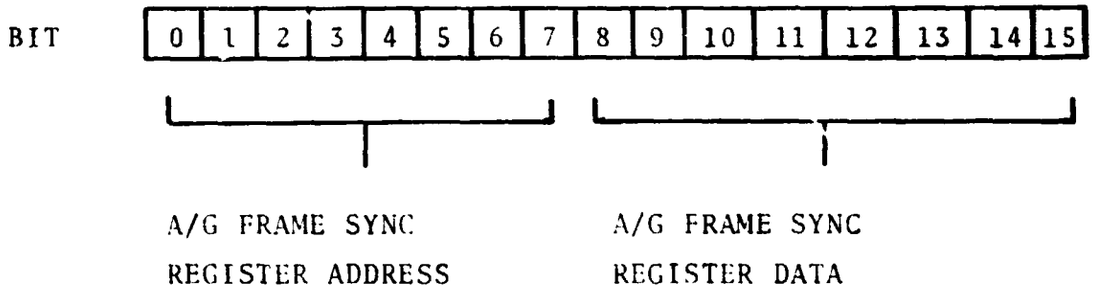


Figure 4. Setup Data Word Format

4.1.3 Status Words. The TPC may read the status of the component by executing a Read Status Instruction. The format of the Status Word is shown in figure 5.

4.1.4 NCI Control Interface Operation

4.1.4.1 Initialization. The TPC shall initialize the component to the setup mode by executing a Start Setup Command. Upon receipt of the Start Setup Command, the component shall set the Setup Mode Status Bit (Bit 9) and respond with an interrupt to the TPC. The TPC may check the component status word to verify that it is in the Setup Mode. The TPC shall always check the status word for the condition of the AUTO Bit. If the AUTO Bit indicates that the NCIU Control Panel is in the manual mode, the TPC shall not issue Setup Data words to the component.

4.1.4.2 A/G Frame Synchronizer Setup Data Words Transfer. Setup Data Words shall be transferred via programmed I/O. After each setup word has been received and transferred to the NCIU, the component shall issue an interrupt to the TPC indicating that the component is ready for the next setup word.

4.1.4.2.1 A/G Frame Synchronizer Control. The operation of the A/G Frame Synchronizer (AGFS) is controlled by 13 registers, numbered 0 through 11, and 15. Registers 0 through 11 provide information on the data format needed by the AGFS. Initialization of the AGFS requires that the following steps be performed.

a. Clear Register 15

b. Load registers 0 through 11 (Register 12 is used for the Delta Time Counter)

c. Send GO command to Register 15.

The first step is necessary because a GO in Register 15 inhibits data from being written into the other registers. Registers 0 through 15 shall contain the following information:

- Register 0. Number of bits per word in 2's complement; four bits.

BIT	8	9	10	11	12	13	14	15
STATUS	AUTO	SETUP	READ MODE	STATUS	N/U	N/U	N/U	N/U

BIT 8 Auto. Indicates the current auto/manual mode of the NCIU control panel

BIT 9 Setup Mode. Indicates that the component is in the setup mode

BIT 10 Read Mode. Indicates that the component is in the read mode (Refer to Paragraph 4.3)

BIT 11 Status. Indicates that a BDF status counter overflow condition is pending (Refer to Paragraph 4.3)

BITS 12 through 15 not used.

Figure 5. NCIU Control Status Word Format

4.1.4.2.1 A/G Frame Synchronizer Control. (continued)

- Register 1. Sync tolerance in binary form; four bits.
- Registers 2 and 3. Words per frame in 2's complement; 13 bits.
- Register 4. (Lock Register) Number of consecutive out of tolerance sync patterns before returning to search from lock in binary; four bits.
- Register 5. (Check Register) Number of consecutive out of tolerance sync patterns before advancing from check to lock in binary; four bits.
- Registers 6, 7, 8 and 9. Sync code; 32 bits. The LSB of Register 6 is always the leading bit of the sync pattern. Codes are leading bit justified, i.e., a ' -bit pattern will be contained in Registers 6 and 7.
- Register 10. Number of bits in sync code minus 1; five bits.
- Register 11. Number of data words in sync code in 1's complement; four bits.
- Register 12. Offset for Delta Time Counter; eight bits. The offset is the 2's complement of 32 plus the sync code length plus the number of bits per word.
- Register 15. Contains the GO, TERMINATE, RESTART, DIGITAL VOICE, and RESET commands. All are positive logic levels. The reset command clears all registers to zero. It must be used with care as it will cause an abnormal NCIU termination if used while the unit is running.

The hexadecimal address for each register is the most significant eight bits of the TPC word. The data is located in the least significant eight bits. See table 1.

TABLE 1

REG NO.	HEX ADD	MSB							LSB	FUNCTION
0	10	X	X	X	X	3	2	1	0	BITS/WORD
1	11	X	X	X	X	3	2	1	0	SYNC TOLERANCE
2	12	7	6	5	4	3	2	1	0	WORDS/FRAME
3	13	X	X	X	12	11	10	9	8	WORDS/FRAME
4	14	X	X	X	X	3	2	1	0	LOCK REGISTER
5	15	X	X	X	X	3	2	1	0	CHECK REGISTER
6	16	7	6	5	4	3	2	1	0	SYNC CODE
7	17	15	14	13	12	11	10	9	8	SYNC CODE
8	18	23	22	21	20	19	18	17	16	SYNC CODE
9	19	31	30	29	28	27	26	25	24	SYNC CODE
10	1A	X	X	X	4	3	2	1	0	BITS IN SYNC CODE
11	1B	X	X	X	X	3	2	1	0	WORDS IN SYNC CODE
12	1C	7	6	5	4	3	2	1	0	DELTA TIME OFFSET
15	1F	RST	X	X	X	DV	RSRT	TRM	GO	COMMANDS

X = UNUSED BITS

4.1.4.3 Setup Data Flow Termination. When the TPC has issued the last Setup Data Word, it shall terminate the data flow by executing a Stop Setup Command. The component shall reset its setup mode status bit and return to an idle state.

4.2 OD Data Memory Access Multiplexer Bus Interface. This component shall input Operations Downlink (OD) data from the NCIU to the TPC on a Direct Memory Access (DMA) basis via the TPC Memory Access Multiplexer (MAM) Component. The OD data shall be transferred on a minor frame basis. The number of A/G data words to be packed per buffer word and the bit alignment shall be programmable by component setup parameters supplied by the TPC during the initialization sequence. Refer to paragraph 4.2.2. Allowable packing is either one or two A/G data words per buffer word (16 bits). Allowable bit alignment is LSB right justified regardless of the bit alignment of the incoming data.

4.2.1 MAM Bus Interface/TPC Interface. The MAM component shall interface with the TPC via the TPC MAM bus. This interface shall provide for the following information transfers:

- Command Words from the TPC via programmed I/O
- Component Setup Words from the TPC via Programmed I/O
- Data Words to the TPC via DMA
- Status Words to the TPC via programmed I/O

4.2.1.1 Command Words. The TPC shall control the operation of the OD data components by executing Output Command Instructions to device address X '107' (OD) X '109' (SCA). The format for the command words is shown in figure 6.

4.2.1.2 Setup Word. The TPC shall initialize the component to receive data by issuing a setup word via a Write Halfword Instruction. Format of the setup word is shown in figure 7.

4.2.1.3 Data Word. Data word transfers between the component and the TPC shall be on a DMA basis via the MAM bus. Buffer format and word format for the DMA transfer is shown in figure 8.

BIT	8	9	10	11	12	13	14	15
COMMAND	DI	EI	H/W	N/U	RUN	N/U	N/U	RESET

Bit 8 Disable Interrupt

Bit 9 Enable Interrupt

Bit 10 Halfword. This bit shall be set in all commands

Bit 11 Not used

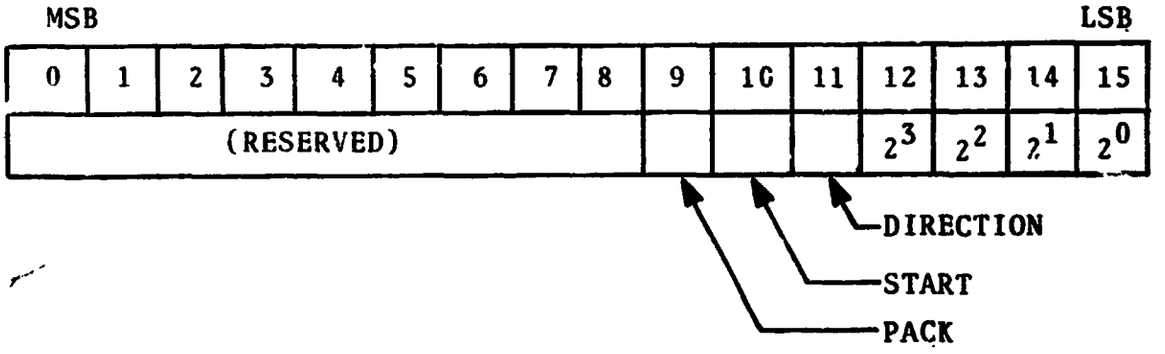
Bit 12 Run Bit. 1 = Run, 0 = Halt

Bit 13 Not used

Bit 14 Not used

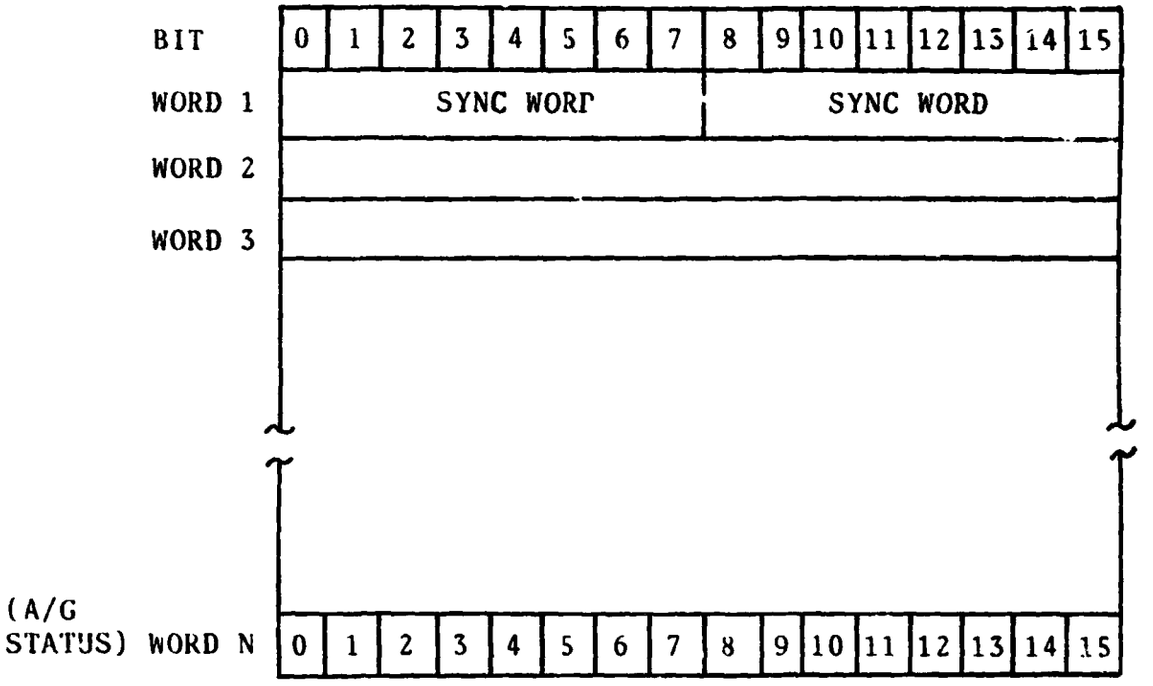
Bit 15 Reset Bit. 1 = Reset Component

Figure 6. Command Word Format



Bits 0 through 8	Not used. Reserved for expansion
Bit 9	Pack. If this bit is 0, input one OD syllable per halfword. If this bit is 1, input two OD syllables per halfword.
Bit 10	Start. If this bit is 0, pack the first syllable in bits 0 through 7. If this bit is 1, pack the first syllable in bits 8 through 15. Note that Bit 10 is used only if Bit 9 is 1.
Bit 11	Direction. If this bit is 0, assemble OD bits left to right. If this bit is 1, assemble OD bits right to left.
Bits 12 through 15	Starting Bits. When Bit 11 is 0, Bits 12 through 15 are set to starting bit minus 1. When Bit 11 is 1, Bits 12 through 15 are set to starting bit plus 1.

Figure 7. TPC/OD Interface Setup Format



Bit 0 — Sync Word Good. If bit is set, valid sync has been detected on the next sequential minor frame. If bit is reset, synce on the next sequential minor frame was not found or was out of tolerance. This bit is not used on the SCA/SSD interface.

Bit 1 — OD Sequence Error. If bit is set, one or more words in the minor frame was from a BDF block with a sequence number error.

Bit 2 — Common Restart. If bit is set, a manual restart command was initiated at the MDC front panel. (Refer to Paragraph 4.2.3.1.)

Figure 8. Data Words

Bit 3	Poly Error. If bit is set, one or more words in the minor frame was from a BDF block with a poly code error.
Bit 4	NCIC Halt. If bit is set, the data flow through the NCIC was manually terminated.
Bit 5	NCIU Halt. If bit is set, the data flow from the A/G Frame Synchronizer was terminated either manually or by command from the TPC.
Bits 6 and 7	Mode Status. If bits 6 and 7 are reset, the A/G Frame Sync component is in the Search Mode. If bit 6 is set and bit 7 is reset, the component is in the Check Mode. If bit 6 is reset and bit 7 is set, the component is in the Lock Mode.
Bit 8	BDF Header Terminate. If bit is set, the data flow through the NCIC was terminated by detection of the terminate code in the BDF header.
Bit 9	BDF Sync Status. If bit is set, the NCIC did not find BDF sync at the expected time.

Figure 8. Data Words (Cont.)

4.2.1.4 Status Word. The TPC may read the status of the component by executing a Read Status Instruction. The format of the status word is shown in figure 9.

4.2.2 OD Data Component Initialization. The TPC shall initialize data flow from the component by setting the MAM as described in Interdata Publication 29-422. The TPC shall then setup the component by issuing a setup word to describe the desired operation. Bits 9 through 15 shall be as follows:

a. Bit 9 — Pack Control Bit. If the bit is 0, one A/G data word is packed in each buffer word. If the bit is 1, two A/G data words are packed in each buffer word.

b. Bit 10 — Pack Placement Bit. This bit is used only if Bit 9 is 1. If Bit 10 is 0, the first A/G data word is packed in Bits 0 through 7. If Bit 10 is 1, the first A/G data word is packed in Bits 8 through 15.

c. Bit 11 — Assembly Direction Bit. This bit is used in conjunction with Bits 12 through 15 to assemble an A/G data word into the desired bit alignment. If the bit is 0, the A/G data word is assembled left to right, i.e., the A/G data word will be swapped end for end. If the bit is 1, the A/G data word will be assembled in the same alignment as it is downlinked.

d. Bits 12 through 15 — Assemble Start Bits. These bits specify the assembly register location into which the first bit of an A/G data word will be placed. When Bit 11 is 0, Bits 12 through 15 are set to the desired starting bit location minus one. When Bit 11 is 1, Bits 12 through 15 are set to the desired starting bit location plus one.

BIT	8	9	10	11	12	13	14	15
STATUS	RUN	NCIC OFF	NCIU OFF	N/U	CHECK	LOCK	OVERFLOW	N/U

Bit 8 Run

Bit 9 NCIC Off

Bit 10 NCIU Off

Bit 11 Not used

Bits 12 and 13 Mode Status

Bit 12	Bit 13	Mode
0	0	Search
1	0	Check
0	1	Lock

Bit 14 Overflow

Bit 15 Not used

Figure 9. Component Status Word Format

4.2.2.1 Setup Word Example. In the following example, the A/G data words are assumed to be 6-bit words with the MSB first. The desired buffer word is LSB right justified with two A/G data words per buffer word and the first syllable in the least significant byte. Bits 9 through 15 in the setup word would be as follows:

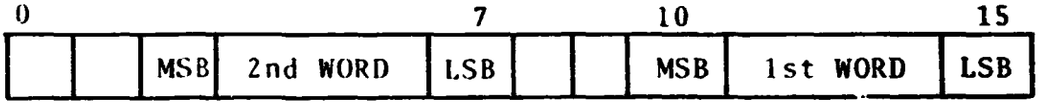
a. Bit 9 — This bit is 1. Two A/G data words are packed in each buffer.

b. Bit 10 — This bit is 1. The first A/G data word is packed in bits 8 through 15.

c. Bit 11 — This bit is 0. The A/G data word is assembled left to right.

d. Bits 12 through 15 — These bits are 1001, respectively. They indicate that the first bit of the A/G data word is in bit position 10 (9+1) and assembles the remaining bits from left to right (as set by Bit 11) such that the LSB is assembled in bit position 15.

The resulting data word is as follows:



4.2.3 OD Data Component Run Operation. After the component is setup by the TPC, the TPC shall then start data flow by issuing a command with Bits 9, 10, and 12 set. The component shall respond to the TPC command by setting the run bit in the status word and wait for the next minor frame of data from the NCIU. Upon receipt of this data, the component shall then process it as specified by the TPC setup word and input the data to the TPC on a DMA basis. Automatic buffer toggling on a minor frame basis shall be provided by the MAM as described in Interdata Publication 29-422.

4.2.3 OD Data Component Run Operation. (continued)

The first word(s) of each buffer shall contain the A/G Sync Word(s). The last word of each buffer shall be an A/G Status Word. The format of the A/G Status Word is shown in figure 8.

4.2.3.1 Error Conditions. The component, in conjunction with the A/G Frame Sync, shall perform as follows for each given error condition.

a. OD Sequence Error. The remainder of the current minor frame is "filled" and the A/G Frame Sync returns to the search mode. The Sequence Error Bit in the A/G Status Word is set, and the Search mode bit in the Component Status Word and A/G Status word is set.

b. Common Restart. The remainder of the current minor frame is filled and the A/G Frame Sync returns to the search mode. The Common Restart Bit in the A/G Status Word is set, and the search mode bit in the Component Status Word and the A/G Status Word is set.

c. Poly Error. Sets Poly Error Bit in the A/G Status Word.

d. Loss of Sync. A/G Frame Sync component returns to search mode. The Search mode bit in the Component Status Word and A/G Status Word is set.

4.2.4 OD Data Component Halt Operation. Operation of the OD Data Component shall continue until halted by any one of the following conditions:

- TPC Command
- NCIC Halt
- NCIU Halt
- Component Buffer Overflow

4.2.4.1 TPC Command. Upon receipt of the Halt Command (Bits 8 and 10 set), the component shall reset the Run Bit in Status word and cease to transfer data.

4.2.4.2 NCIC Halt. When data flow through the NCIC is halted, either manually or automatically, the component shall set the NCIC OFF bit in the Status Register.

NOTE

Under this condition, the A/G Frame Sync fills the remainder of the current minor frame and then stops sending data.

4.2.4.3 NCIU Halt. When data flow through the NCIU is halted, either manually or automatically, the component shall set the NCIU OFF bit in the status register.

NOTE

Under this condition, the A/G Frame Sync continues to the end of the current minor frame and then stops sending data.

4.2.4.4 Component Buffer Overflow. Should the internal temporary storage buffer overflow, for any reason, the component shall set the overflow bit in the status register and cease to transfer data.

4.3 Delta Time and BDF Status Component. The Delta Time and BDF Status Component shall provide the TPC with Delta Time Word Sets generated by the NCIU and BDF Status error counts generated by the NCIC.

4.3.1 Component/TPC Interface. The Delta Time Component shall interface with the TPC via its multiplexer bus. This interface shall provide for the following information transfers.

- Command words to the component from the TPC via programmed I/O.
- Delta Time and BDF Status words from the component to the TPC via programmed I/O.
- Status words from the component to the TPC.

4.3.1.1 Command Words. The TPC shall control the operation of the component by executing output command instructions to device address X '05'. The format of the command word is shown in figure 10. The device address for this component is common with the device address for the NCIU Control Interface Component described in Paragraph 4.1. The Read Command Word shall set the interface to the Read Mode. Bits 9, 10, and 13 shall be set in the Read Command Word; all other bits shall be reset. A Read Command Word or a Read Count Command Word shall be required to operate the interface.

4.3.1.2 Delta Time and BDF Status Words. Delta Time and BDF Status words shall be transferred between the component and the TPC on a fixed format block of eight halfwords. Format of the status block is shown in figure 11.

4.3.1.3 Status Words. The TPC may read the status of the component by executing a Read Status Instruction. The format of the status word is shown in figure 12.

BIT	8	9	10	11	12	13	14	15
COMMAND	DI	EI	H/W	N/U	SET UP	READ MODE	READ COUNT	N/U

Bit 8 Disable Interrupt

Bit 9 Enable Interrupt

Bit 10 Halfword. This bit shall be set in all commands.

Bit 11 Not used

Bit 12 Setup. Initializes the component to receive A/G Setup Words.

Bit 13 Read Mode. Initializes the component to output delta time and BDF status.

Bit 14 Read Count. Command for the interface to read the BDF status counters.

Bit 15 Not used

Figure 10. Read Command Word Format

BIT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
WORD 1	RSDP Time Tag - Day/Hours															
WORD 2	RSDP Time Tag - Minutes/Seconds															
WORD 3	RSDP Time Tag - Milliseconds															
WORD 4	Delta Time Count															
WORD 5	Blocks Received Count															
WORD 6	Sequence Errors Count															
WORD 7	Poly Errors Count															
WORD 8	Unroutable Msg Count															

Figure 11. Status Block Format

BIT	8	9	10	11	12	13	14	15
STATUS	AUTO	SET UP	READ MODE	STATUS	N/U	N/U	N/U	N/U

Bit 8 — Auto. Indicates the current automatic/manual mode of the NCIU control panel.

Bit 9 — Setup. Initializes the component to receive A/G Setup Words.

Bit 10 — Read Mode. Indicates that the component is in the Read Mode.

Bit 11 — Status. Indicates BDF status counter overflow condition.

Bits 12 through 15 — Not used

Figure 12. Status Word Format

4.3.2 Delta Time and BDF Status Component Operation

4.3.2.1 Initialization. The TPC shall initialize the component to the Read Mode by executing a Read Command. Upon receipt of the Read Command the component shall set the Read Mode status bit.

4.3.2.2 Delta Time and BDF Status Word Transfers. After initialization, the component shall await notification by the NCIU that a Delta Time Word Set is ready for transfer. Upon this modification, the component shall read the Delta Time Word Set from the NCIU and the BDF Status from the NCIC. The component shall then respond with an interrupt to the TPC. The eight words shall then be transferred to the TPC via the programmed I/O. The component shall respond with an interrupt to the TPC after each word is transferred to the TPC.

The component shall automatically remain in the Read Mode unless commanded into the Setup Mode by the TPC; refer to Paragraph 4.1. While in the Read Mode, Delta Time Transfers shall continue, as described above, each time the NCIU collects a new Delta Time Data Set.

The TPC shall check the status word for the first word transfer of each block for the condition of the Status overflow Bit. If the Status Bit is set, the transfer of the block of data was caused by a pending overflow of the BDF Status Counters and the Delta Time Word Set in that block is not valid.

4.3.2.3 Read Count Command Mode. If Delta Time Data is not being processed, the TPC may read the BDF Status Words by executing a Read Count Command. Upon receipt of this command, the component shall read the BDF status from the NCIC and transfer the collected data to the TPC in the format shown in figure 11. For this mode the Delta Time Word Set is not valid. After the BDF Status is received by the TPC, the TPC must execute a Read Command to return the component to the Read Mode.

4.4 TPC to Standard Peripherals Interface Characteristics. The physical and electrical characteristics common to the following TPC interfaces shall be as described in Interdata Publication 29-311.

4.4.1 TPC/Moving Head Disc Interface. The characteristics for this interface shall be as described in Interdata Publications 29-387 and 29-400.

4.4.2 TPC/Alphanumeric Terminal Interface. The characteristics of the TPC to Programmable Asynchronous Line Adapter (PASLA) interface shall be as described in Interdata Publication 29-301. The output interface of the PASLA shall be a standard RS-232 interface to a Hazeltine 2000G commercial terminal.

4.4.3 TPC/Magnetic Tape Drive Interface. The characteristics of the internal tape drive system interfaces including the tape controller interfaces shall be as described in Interdata Publication 29-309. Additional software interface data is described in Interdata Publication 29-309R05.

4.4.4 TPC/Line Printer Interface. The characteristics of this interface shall be as described in Interdata Publications 29-313, 29-316, and 29-317.

4.4.5 TPC/Card Reader Interface. The characteristics of this interface shall be as described in Interdata Publications 29-305 and 29-383.

4.4.6 TPC/Carousel Console Interface. The characteristics of this interface shall be as described in Interdata Publications 29-455 and 29-456.

4.5 MITE Time Interface Component. The MITE Time Interface Component shall provide an interface between the MCC MITE System and the TPC. This interface shall permit the TPC to access the MITE GMT time of year data.

4.5.1 MITE Time Interface Component/TPC Interface. The MITE Time Interface Component shall interface with the TPC via its multiplexer bus. This interface shall provide for the following information transfers.

- Command words from the TPC to the component via programmed I/O.
- MITE GMT time of year data words.
- Status words from the component to the TPC.

4.5.1.1 Command Words. The TPC shall control the operation of the component by executing output command instructions to device address X '47'. The format of the command word is shown in figure 13. A Read Time command shall be required each time the TPC desires to read the MITE GMT time of year data. The Read Time Command shall initiate the component to obtain the current GMT time. Bits 9, 10, and 12 shall be set in the Read Time Command.

4.5.1.2 MITE GMT Time of Year Data. GMT time of Year Data shall be transferred between the component and TPC in a fixed format block of four words. The format blocks format is shown in figure 14.

4.5.1.3 Status Words. The TPC may read the status of the component by executing a Read Status instruction. The format of the Read Status Word is shown in figure 15.

BIT	8	9	10	11	12	13	14	15
COMMAND	DI	EI	H/W	N/U	READ TIME	N/U	N/U	N/U

Bit 8 — Disable Interrupt

Bit 9 — Enable Interrupt

Bit 10 — Halfwor[illegible]. This bit shall be set in all commands.

Bit 11 — Not used

Bit 12 — Read Time. Initializes the component to collect and transfer the current MITE GMT time of year.

Bits 13 through 15 — Not used

Figure 13. Read Time Command Word Format

BIT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
WORD 1					800	400	200	100	80 (DAYS)	40	20	10	8	4	2	1
WORD 2	80 (HOURS)	40	20	10	8	4	2	1	80	40	20	10	8 (MINUTES)	4	2	1
WORD 3									80	40	20	10	8 (SECONDS)	4	2	1
WORD 4					800	400	200	100	80 (MILLISECONDS)	40	20	10	8	4	2	1

Figure 14. MITE GMT Block Format

BIT	8	9	10	11	12	13	14	15
STATUS	TIME WORD	N/U	N/U	N/U	N/U	N/U	N/U	N/U

Bit 8 — Time Word. Indicates that the word transferred is a Delta Time Word.

Bits 9 through 15 — Not used

Figure 15. Read Status Word Format

4.5.2 MITE GMT Interface Component Operation

4.5.2.1 Initialization. The TPC shall initialize the component to read the current MITE GMT time of year by executing a Read Time Command. Upon receipt of the command the component shall acquire the current time of year data from the IRIG Time Reader component.

4.5.2.2 MITE GMT Time of Year Data Transfers. After acquisition of the current time by the component, it shall respond with an interrupt to the TPC. The four time words shall then be transferred to the TPC via programmed I/O. The component shall respond with an interrupt to the TPC after each word is transferred to the TPC. The Time Word status bit shall also be set for each time word transfer.

4.6 Wideband Serializer Component. The Wideband Serializer component shall access reformatted 56 kb/s buffer(s) from the TPC on a DMA basis via the TPC MAM component. The received data shall be in a 16-bit parallel, word serial form. The Wideband Serializer shall perform a parallel to serial conversion and output a bit continuous data stream at 56 kb/s. A synchronous 56 kb/s data clock shall also be provided as an output. The data and clock outputs shall be provided to the MCC FACS for routing to the ALTDS.

4.6.1 TPC/Serializer Interface. This interface shall provide for the following information transfers:

- Command words from the TPC to the serializer via programmed I/O
- Setup Data words to the serializer via programmed I/O
- Data words from the TPC to the serializer via DMA
- Status words from the serializer to the TPC via programmed I/O.

4.6.1.1 Command Words. The TPC shall control the operation of the serializer by executing Output Command Instructions to device address X '139'. A Start Command and Stop Command shall be required. The format of the Serializer Command is shown in figure 16.

4.6.1.1.1 Start Command. The Start Command shall reset the serializer and then initiate the parallel to serial conversion process. Bits 9, 10, and 12 shall set in the start command word, all other bits shall be reset.

4.6.1.1.2 Stop Command. The Stop Command shall halt the parallel to serial conversion process when the FIFO buffer becomes depleted. Bits 9, 10, and 13 shall be set in the Stop Command Word; all other bits shall be reset.

BIT	8	9	10	11	12	13	14	15
COMMAND	DI	EI	N/W	N/U	START	STOP	N/U	N/U

BIT 8 DISARM Interrupt

BIT 9 Enable Interrupt and DISARM Interrupt

BIT 10 Halfword. This bit shall be set in all commands

BIT 11 Not us

BIT 12 START

BIT 13 STOP

BIT 14 Not used

BIT 15 Not used

Figure 16. Serializer Command Word Format

4.6.1.2 Setup Data Word. Prior to transmitting a Start Command to the Wideband Serializer component, the TPC shall send one data word to specify the manner in which the WBD is to be serialized. The serializer shall be capable of serializing a programmable number of bits (from 4 to 16) per 16-bit computer word. The direction in which the serialization is performed must be specified. In addition, the location of the first bit of a word to be selected by the serializer must be specified.

All parameters are contained in bits 7 through 15 of the Setup Data Word. The value for the number of bits per word in the Setup Data Word is the actual number of bits minus 1. The position of the first bit to be serialized is a binary value from 0 to 15. The format of the Setup Data Word is shown in figure 17.

4.6.1.3 Data Words. Data word transfers between the TPC and the serializer shall be on a DMA basis via the MAM bus. Buffer format for the DMA transfers shall be as shown in figure 18.

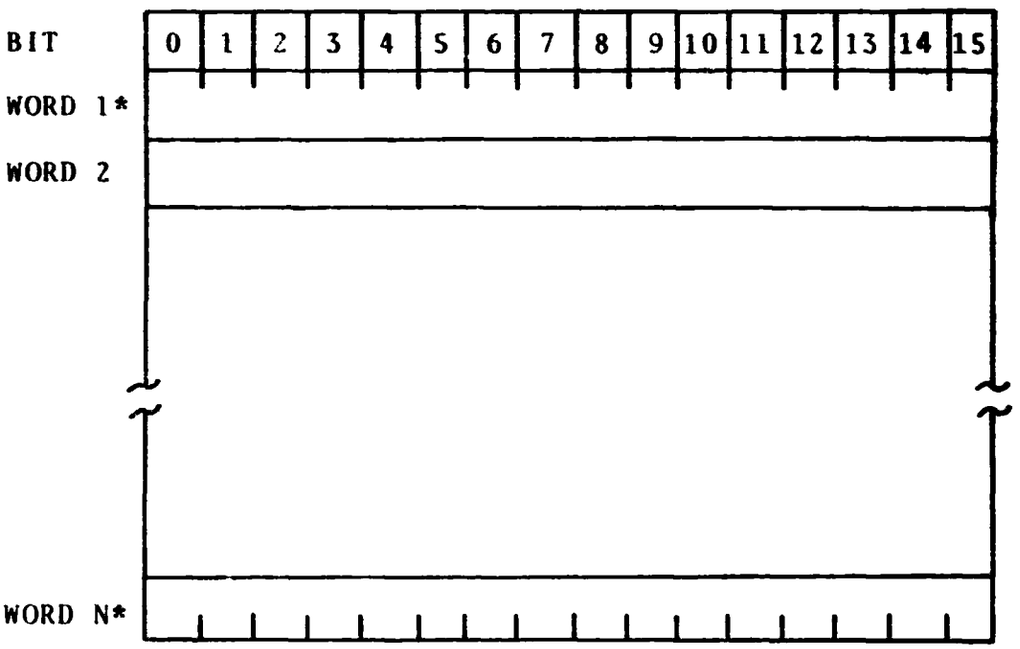
4.6.1.4 Status Words. The TPC may read the status of the serializer by executing a Read Status instruction from the device address. The format of the Serializer Status Word is shown in figure 19.

4.6.1.5 Serilizer Initialization. The TPC shall initialize data flow to the serializer component by setting up the MAM as described in Interdata Publication 29-422. After the MAM is setup, the TPC can start serializer data flow at any time by sending a Setup Data Word to the Serializer component and executing a Start command.

4.6.1.6 Serializer Operation. The Serializer shall have both a Run and Halt state. The operation of the Run State and Halt State is explained in the following paragraphs.

BIT	7	8	9	10	11	12	13	14	15
VALUE	2^3	2^2	2^1	2^0	SHIFT	2^3	2^2	2^1	2^0
FUNCTION	BITS/WORD				LEFT	BIT SELECT			

Figure 17. Serializer Setup Data Word Format



*Both the first word and last word shall be serialized

Figure 18. Buffer Block Format

BIT	8	9	10	11	12	13	14	15
STATUS	RUN/ HALT	N/U	INPUT ERROR	DEPLETE	N/U	N/U	N/U	N/U

Bit 8 — Run/Halt. If this bit is 1 (Run), the serializer is processing data. If this bit is 0 (Halt), the serializer is not processing data.

Bit 9 — Not used

Bit 10 — Input Error. This bit indicates that the allowable input data rate is exceeded.

Bit 11 — Deplete. This bit indicates that the serializer buffer has been depleted.

Bits 12 through 15 — Not used

Figure 19. Serializer Status Word Format

4.6.1.6.1 Serializer Run State. Upon receipt of the Start command from the TPC, the Serializer component shall automatically reset its control logic, set the Run/Halt bit, and send an interrupt to the MAM. Data shall then be transferred between the TPC and Serializer component on a DMA basis via the MAM bus. The buffer format for the DMA transfers shall be as shown in figure 17. As each received 16-bit data word is serialized, the Serializer component shall request a new word from the TPC by sending an interrupt to the MAM. The Serializer component shall provide for internal buffering of up to 64 data words in order to prevent time criticality of the DMA access. Should any condition cause the serializer buffer to overflow or be depleted, the Serializer component shall notify the TPC by setting the appropriate bit in the Serializer Status Word (refer to figure 18). Automatic buffer toggling shall be provided by the MAM as described in Interdata Publication 29-422. Serializer operation shall continue until the TPC sends a Stop command (refer to figure 16).

4.6.1.6.2 Serializer Halt State. Upon receipt of the Stop command from the TPC, the Serializer component shall stop requesting data from the TPC. The Serializer shall then clear the internal buffer by serializing any remaining words. When the internal buffer is cleared, the Serializer component shall reset the Run/Halt Bit in the Serializer Status Word, and inhibit its serial data and clock outputs.

4.6.1.6.3 Serializer Output Interface. The Serializer component shall, in addition to the TPC and MAM outputs, provide NRZ and clock data to the FACS.

4.7 IRIG B Time Code Converter. The IRIG B time Code Converter component shall receive Spacecraft GMT in a parallel BCD format from the TPC once a second. The component shall then perform a parallel-to-serial IRIG B conversion on the received data.

4.7.1 IRIG B Time Code Converter/TPC Interface. The component shall interface with the TPC via the TPC MAM bus. The interface shall provide for the following data transfers:

a. Command words from the TPC to the component via programmed I/O

b. Spacecraft time words from the TPC to the component via programmed I/O

c. Status words to the TPC from the component.

4.7.1.1 Command Words. The TPC shall control the operation of the component by executing output command instructions to device address X '47'. Both a Start Conversion Command and a Stop Conversion Command shall be required to control the component. The format of the command word is shown in figure 20.

4.7.1.1.1 Start Conversion Command. The Start Conversion Command shall instruct the component to convert the Spacecraft time to IRIG B. Bits 9, 10, and 13 in the IRIG Time Code Converter Command Word shall be set.

4.7.1.1.2 Stop Conversion Command. The Stop Conversion Command shall instruct the component to stop conversion of the Spacecraft time to IRIG B. In the IRIG Time Code Converter Command Word, Bits 9 and 10 shall be set and Bit 13 shall be reset.

4.7.1.2 Spacecraft Time Words. Spacecraft Time Words shall be transferred between the component and the TPC on a fixed format block of two halfwords. The format of the IRIG B Spacecraft Time Word block is shown in figure 21.

BIT	8	9	10	11	12	13	14	15
COMMAND	DI	EI	H/W	N/U	READ TIME	START CONV	N/U	N/U

Bit 8 — Disable Interrupt

Bit 9 — Enable Interrupt

Bit 10 — Halfword. This bit shall be set in all commands.

Bit 11 — Not used

Bit 12 — Read Time. Initializes the transfer of time data.

Bit 13 — Start Conversion. When this bit is 1, the component shall start time conversion. When this bit is 0, the component shall stop time conversion.

Bits 14 and 15 — Not used.

Figure 20. IRIG Time Code Converter Command Word Format

BIT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
WORD 1	40	20	10	8	4	2	1	40	20	10	8	4	2	1		
	(MINUTES)							(SECONDS)								
WORD 2	200	100	80	40	20	10	8	4	2	1	20	10	8	4	2	1
	(DAYS)										(HOURS)					

Figure 21. IRIG B Spacecraft Time Word Block Format

4.7.1.3 Status Words. The TPC may read the status of the component by executing a Read Status Instruction. The format of the IRIG B Time Code Converter Status Word is shown in figure 22.

4.7.2 IRIG B Time Converter Operation

4.7.2.1 Initialization. The TPC shall initialize the component to the Read Mode by sending a Start Conversion Command. Upon receipt of this command, the component shall set the Run Mode Bit in the Status Word.

4.7.2.2 Spacecraft Time Word Transfer. Upon receipt of the Start Conversion Command, the component shall respond with an interrupt to the TPC. The TPC shall then respond to the component interrupt by outputting the Spacecraft Time Words. The component shall send an interrupt to the TPC upon receipt of each Spacecraft Time Word. After the initial set of Spacecraft Time Words have been transferred, the TPC shall output sets of time words at a once a second rate. The allowable tolerance for the once a second rate is plus or minus 5 milliseconds.

4.7.2.3 Halt Operation. The TPC may stop Spacecraft Time conversion at any time by outputting a Stop Conversion Command to the component. Upon receipt of this command, the component shall reset the Run Mode Bit in the Status Word and return to an idle state.

BIT	8	9	10	11	12	13	14	15
STATUS	TIME WORD	RUN MODE	N/U	N/U	N/U	N/U	N/U	N/U

Bit 8 — Time Word. Indicates that the word transferred is a Delta Time Word.

Bit 9 — Run Mode. Indicates the component is processing time words.

Bits 10 through 15 — Not used

Figure 2. IRIG B Spacecraft Time Status Word Format

5. QUALITY ASSURANCE PROVISIONS

Not applicable

6. PREPARATION FOR DELIVERY

Not applicable

7. NOTES

None